

FIRE SHELTER AND PERSONAL PROTECTIVE EQUIPMENT PERFORMANCE ON THE LAUDER FIRE

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INTRODUCTION

On September 29, 1987, approximately at 10 o'clock in the morning, five members of a California Department of Forestry helitack fire suppression crew were entrapped and burned while fighting the Lauder Fire near Willits, California. There was one fatality.

Because fire shelters were deployed by the entrapped crew, the Missoula Technology and Development Center (MTDC) was asked to review the performance of fire shelters. We also took the opportunity to review the performance of other personal protective equipment (PPE). This review was conducted on October 2 and 3, 1987, and consisted of: (1) Examining the fire shelters, available clothing, and other PPE articles used by the entrapment victims; (2) Interviewing people knowledgeable about the incident (Appendix A); and (3) Visiting the entrapment site.

We did not talk to any of the entrapment victims and our information on actual entrapment details were provided by CDF personnel.

FINDINGS

ENTRAPMENT SITUATION

The following are excerpts from information provided by the California Department of Forestry Investigation Team regarding the entrapment situation: "... (The five person crew) had arrived at a point on the right flank (of the fire).... They were cutting an access trail northwesterly... and had progressed about 30 to 40 feet when they became aware of fire activity below them. While this activity could not be seen, they could hear the fire building. At this point, several things occurred; one crew member went back down the trail a very short distance and realized their trail was overrun with fire; the two that were in the lead in cutting the line ... were in a heavy brush field and attempted to locate a way across the brush field to flank the fire. The brush was much too thick to attempt, and the escape route was blocked. There was considerable concern for their safety and a short pause in the intensity of the fire. Following the small run, a second and very pronounced fire run continued directly below them. They saw flame lengths in excess of 20 feet and stated (that) all hell broke loose.

... The Captain had stated (that) their escape route would be into the adjacent burn.... They had been staying in view of the (burn) perimeter on their way up the hill. The problem occurred when they ran into the main burn (and) temperatures were much too severe to prevent serious radiant burns. The location (a small bench) where they deployed the shelters was purely happenstance. Their intent was to run into the burn for escape, but having confronted the large down logs and the intense heat, they had to deploy their shelters in sheer preservation. All had varying degrees of burns that they were aware of prior to shelter deployment."

Key findings are:

.Apparently the crew tried all avenues of escape before resorting to their fire shelters.

.The bench where they ultimately deployed their shelters was very small, about 25 feet in diameter and surrounded by heavy fuels. Looking upslope, several 3- to 4-foot diameter fir logs and stumps provided heavy residual fuels on the left side of the deployment site. The primary slope of the entrapment site is east-facing and, except for the bench, has an approximate 70-percent slope.

.With the combination of steep slope and heavy fuels, the fire burned very intensely. Scorch heights of 16 feet on some of the oak trees surrounding measured by investigation team support personnel. Two small fir trees adjacent to the site have branches swept back and permanently set by the intense heat. Surprisingly, aerial fuels were not burned in the area immediately surrounding the site.

.The entrapment site appeared to be the best fire shelter deployment site in close proximity to the crew.

.According to the findings of the CDF Investigation Team, the "victims were burned on both the front and back of their legs and (had) facial burns from a line that would approximate that covered by the normal wearing of the helmet. This line was evident on several of the firefighters' face, temporal area, ears and neck. This confirmed that helmets were worn up to the point they entered the shelters. The Fire Captain states his helmet, which was located down the hill below the victims' and (was) severely burned, was either blown off or knocked off in the deployment activity. While there was ample evidence of radiant heat, there was also pronounced evidence of contact burns on the victims. Jeff Smith, who (is believed to have had) the shelter without the hold-down straps, (flaps) had severe burns to knuckle areas and sides of both hands, underside of the arms below the elbows and on the knees. These were large blister-type burns from the hot material on the ground and not radiant heat. Similar burns were on firefighters Murias, Brown and on the Captain, although much less pronounced on the hands and knuckle area. Jeff Smith states that he had difficulty in holding the shelter down and used both knees and hands to grab the shelter flaps and hold it against the ground. All stated they were unable to remain in any position for over 15 or 20 seconds. The temperatures were so severe on the ground they had to keep rolling and tossing and changing positions to minimize being burned."

.After shelters were deployed, water was dropped by the helitack helicopter in an attempt to cool the area and extinguish flames surrounding the entrapment site. Later, retardant was also dropped on the site. Elapsed times between the shelter deployments and the water and retardant drops were not obtained.

.The entrapment began about 10:05 a.m. and lasted for approximately 45 minutes before the first rescue person arrived in the area.

.Rescuers said that a signal mirror was extremely valuable in assisting the helicopter to lead rescuers to the entrapment site. They added that a high-pitched whistle sound on the radio of one of the entrapment victims was also helpful.

.Members of the Department of Forestry Resources Management Unit in Ukiah did an excellent job of mapping and photographing the entrapment site. These photos were to be made available to us, so we did very limited filming during our site visits (figures). We later learned that the photos and map could not be provided to us at this stage in CDF's investigation.

FIRE SHELTERS

All five crewmen deployed shelters on the small bench.

Key findings are:

.When the rescuers first arrived, they could not find the entrapment site until the crew captain sat up. He sat up and was attempting to keep other survivors covered with their shelters.

.Because they had been deployed as envelopes, the survivors' shelters had extremely low profiles and blended into the ash and retardant to the extent that they were barely visible.

.Upon the arrival of the first rescue person, the deceased was protruding out of the shelter from approximately the waistline up. However, there had been considerable activity with the deceased, and the exact position he was in and the extent he was ever covered by the shelter is questionable.

.The fatality victim reportedly had difficulty getting into his fire shelter. The CDF investigative team felt that this was due to panic, physical impairments due to radiant burns, or a combination of both. The decedent's first location was immediately adjacent and touching a burning log chunk, described as about 20 inches in length. Apparently, the victim kept trying to get up and run, and the Fire Captain had difficulty keeping him in the safest place. The investigative team reported that the Fire Captain provided considerable assistance to the extent he was able, and probably aggravated his own condition by his repeated exposure in this attempt. The first rescuer to reach the site stated that he believed the fatality victim had never been completely underneath his shelter. While the victim did have considerable burns on his face, and body. It is difficult to determine whether the burns occurred after he died or during or prior to the shelter deployment period.

.At the time of rescue, all five people were positioned with their feet toward the advancing fire. They were immediately adjacent and parallel to each other. Their shelters touched or may have even overlapped each other. The deceased was in the left end position, nearest the heaviest concentration of large logs and stumps. The ribbons in figure 1 show the approximate position of each person.

.According to investigators, "All interviewed said that there was movement at different times, some as much as 8 or 10 feet, in an attempt to find cooler ground to lie on. There was some shifting that ultimately resulted in them being fatally close together in the final resting position...(marked by the ribbons). It is incorrect to assume they were in the same position the whole time. Firefighter Brown speaks of being below them some 10 to 12 feet. Firefighter Murias was farther to the right about 8 or 10 feet. They were all in a general area, certainly close enough that they could communicate by hollering back and forth, and they could hear what was going on. They were...generally positioned at all times with their heads up the slope. We

were unable in our investigation to establish the exact location of the victims during the period of time prior to rescue.

..All describes and there was frequent change of position. As to the position of the deceased and the others when rescuers arrived, it was after water drops, the passage of time, and the general cooling down of the area. Their final position on rescue would have been one of waiting for the rescue to occur. No one was up or moving about and all had sustained severe burns. This may account for their positioning which would turn the least burned area toward the greater heat source of the logs to the south...there was no second burning of the area. The fire that initially passed through this area some 15 to 20 minutes prior was, according to our investigation, the only fire that occurred."

.Photos of the deceased, retardant residues on the shelters, and comments by rescuers indicate that shelters were not occupied in the recommended fashion. Instead, the occupants either deployed the shelters in an envelope fashion with one side on the ground, or they all eventually squirmed one side of the shelter underneath them. It appears that the shelters were either intentionally deployed in this fashion or later maneuvered into this position to provide a barrier between the occupants and possible hot duff and embers on the previously burned deployment site.

.The first rescuer to reach the scene said that some of the survivors were in the fetal position with their backs toward the greatest heat. Their backs were toward the deceased person's position. Using the shelter in this fashion puts shelter material tightly against the occupant's body. However, the victims' positions may have changed between the time of entrapment and the time of rescue as water drops and a general cooling of the area had occurred. Several of the victims, including the deceased, were found with their hard hats at the foot end of the shelter. They fell off during shelter deployment or subsequent movement.

.The victims all reported that the shelter material and the material on the ground was so hot that they could not remain in one place. Reportedly they rolled from side to side to alter body contact points with ground and the upper half of the shelter that covered them like a blanket. The constant rolling and the modified entry that placed one side of the shelter on the hot ground tangled the victims' legs in the hold-down straps.

.The first person to reach the entrapment site said that three of the victims, excluding the captain and the fatality victim, were wrapped up like cocoons.

.A number of the victims' hands had burns of varying severity caused by the radiant heat before shelter deployment. All reported some difficulty in removing their shelters from the cases, some more than others. The Captain may not have had his gloves on and burns to his hands may have been more severe. He found it very difficult to open the snaps on the carrying case. Another victim, in attempting to remove his web belt to access his shelter, realized that his hands were severely burned, and he had difficulty removing the belt.

.A damage assessment revealed there was no heat damage to four of the shelters. The shelter of the deceased was heavily damaged in the area of the feet and legs and there was brown discolored foil in the area of the flap and skirt. The immediate reaction one has when looking at these shelters is, "Were they in the same fire?" The fatality victim's shelter was definitely under a heavier heat load than the other shelters due to time, spatial, or thermal

difference. It was suggested the fatality victim's shelter may have shielded others from the intense heat from large ground fuels. (A detailed analysis of the fire shelters is included as Appendix I.)

.The deceased had one of the newest model shelters, manufactured by Anchor Industries in 1985 (Contract No. GS-08F-97855). This model has skirt flaps to facilitate hold-down.

.Four of the shelters, all made by Anchor Industries, exhibited no evidence of any cracks in the aluminum that sometimes occur from creasing the foil through carrying and general field use. One shelter, which was made by Cecile Industries in January 1983 (Contract No. GS-085-36256), had some cracks along the fold lines. Reportedly this shelter was used by the crew captain.

.When they arrived on the scene, the rescuers deployed shelters to protect the victims from the sun. Rescuers reported cracks in some of these shelters. When we later visited the entrapment site, we examined a few of the rescuer's shelters. All of those with cracks were manufactured by Cecile. No shelters made by Anchor Industries had cracks.

.The helitack captain, who was the first to reach the entrapment site, said that he had not seen the new pamphlet or video, Your Fire Shelter. However, based upon all interviews, it appears that all CDF employees who are likely to see fire duty, including resource specialists, know how to properly deploy and use the fire shelter.

COMMENTS

The Lauder Fire is the latest in a series of 1987 fire entrapments involving the deployment of fire shelters. There was no evidence to suggest availability of fire shelters influenced the crew's decisions on fire suppression or escape actions. In fact, it appears that the crew deployed shelters totally as a last resort.

Based on the findings of our somewhat cursory investigation, it is very apparent that the shelters did not fail and they saved the lives of the survivors. The role of the shelter in protecting the fatality victim is unclear.

From our perspective, hot burning and smoking material on the ground is the lesser of the entrapment hazards in an extremely hostile thermal environment like this one. We believe Nomex clothing and other PPE will protect the occupant from the hot material on the ground until it can be cleared from underneath the body after the person is inside the shelter. The envelope or cocoon deployment results in an opening that is difficult to seal and one that does not protect the lungs and airways from hot flames and gases. It is far more important to have the maximum air space inside the shelter, which is provided by the pup-tent configuration and to minimize body contact with the shelter material. However, we plan to conduct tests and gather additional data for making future recommendations about entrapment under these conditions.

At least one firefighter had difficulty reaching and removing the fire shelter from its case because his hands were burned. According to the CDF investigative team, all the victims were carrying their shelters in the appropriate location at the back of their web belts. Many fire crews carry their shelters in packs where they are hard to reach and remove. The importance of carrying the shelter on a waist belt at the hip or small of the back where it is easily accessible will be stressed in the facilitator's guide

and in future training. At the recommendation of CED personnel, in the facilitators's guide we will also suggest that crews carry signal mirrors and whistles to aid in locating entrapped crews.

Not everyone is aware of the updated pamphlet and video, Your Fire Shelter. Efforts to make field units aware of these new programs must continue. It is essential that in all agencies employees who are likely to see fireline duty know how to properly deploy and use the shelter.

In spite of continued inspection, some shelters deployed during the 1987 fire season have had cracks. All were manufactured by Cecile Industries. Although to date there has been no evidence that these cracks have compromised protection, there is the likelihood that they could. It seems evident that little confidence can be placed in alerts, directives, and other communications to emphasize the need for proper and timely inspections. Therefore, we plan to recommend special procedures for dealing with shelters made by Cecile under the January 1983 Contract No. GS-085-36256.

Based on their experience with the shelters, CDF personnel suggested that the fire shelter be improved by: (1) Putting a plastic liner inside the fabric shelter case to protect the shelter, and (2) Putting solid sections on the ends to eliminate straps that tangle. As a result of findings on the Butte Fire Entrapment, we had already ordered 2,000 liners for a field trial. We plan to decide on final hold-down design changes for the shelter in FY 1988. Unfortunately, all hold-down changes being reviewed add weight and bulk to the shelter. We are also replacing the snaps on the carrying case with velcro hook and pile tape.

ROLE OF OTHER PERSONAL PROTECTIVE EQUIPMENT

Other personal protective equipment (PPE) worn by the helitack crew members played varying roles in the Lauder Fire entrapment.

CLOTHING

Findings--All five crew members wore CDF design yellow, Nomex shirt/ (approximately a 6-ounce weight). Four of the crewmen were wearing CDF design (yellow) Nomex pants of the same weight fabric. The crew captain was wearing an older pair of USDA Forest Service specification (green) Nomex pants made of a similar 6-ounce twill fabric. Three sets of clothing were available for examination. Underwear could not be identified with a particular wearer. We presumed that all five crewmen wore undershirts. Two undershirts (t-shirts) were white. Neither had burns, but both had orange discoloration. It had no burns, but had possible heat discoloration on the right front.

Summary of Clothing Damage

Victim	Shirt	Trouser	Temperature Likely Seen By Garment
Captain	Left and right shoulder heat set and some discoloration. Discoloration on right front.	Basically in burn signs Some heat set on both left and right legs within 12 inches of cuff.	600-700°F
Crewmember S	No sign of heat	No signs of heat	<600°F
Crewmember B	Shirt heat set at chest level on front left and right arms heat set and discolored.	Right leg heat set and discolored.	600-700°F
		Left leg small char spot	>750°F
	Back heat set with slight discoloration.		600-700°F

Comments--Nomex flame-retardant clothing did not burn, melt, or disintegrate during the escape attempts or shelter deployment. The firefighters did receive radiant heat and possibly conductive heat burns through the clothing. But, the clothing did not ignite and burn as normal clothing probably would have. One firefighter reportedly poured water on his pants and the water sizzled. This illustrates the value of flame-retardant clothing in an escape situation, especially while deploying shelters and occupying a shelter in a burned area.

There are some differences between the Department of Forestry and the USDA Forest Service wildland firefighter clothing. Most differences are preferential and do not affect function or performance. There are a few garment design features that CDF might want to reevaluate: (1) Replacing the brass shirt zipper with buttons. Although the zipper is backed by a flap, there remains potential for heat conduction through the zipper in escape and entrapment circumstances like those encountered on the Lauder Fire. (2) If they have not already done so, CDF might also want to consider the new Forest Service specification shirt and trouser fabrics. Both would provide better radiant heat protection than the garments worn by the victims. Although some Forest Service crews still wear garments made of the same fabrics that CDF is using, several years ago we switched to a heavier trouser fabric and 2 years ago to a new shirt fabric. These changes were made for greater comfort and better protection.

GLOVES

Findings--Reportedly, all victims received severe second-degree burns to the hands, probably before entrapment. At least one individual's hands were so badly burned that he had difficulty extracting his shelter from its case and deploying it.

Some CDF firefighters said that their gloves are bulky and cumbersome. One firefighter described them as "like working with boxing gloves." Reports on CDF firefighters having difficulty deploying fire shelters with gloves on also emerged from the Crank Fire, so there is some consistency to this concern.

The Cal-OSHA approved CDF glove employs a dark brown Chrome-tanned split-grain leather.

Comments--The dark brown rough-textured split-grain leather used in CDF gloves might not provide optimal radiant heat protection. Split-grain leather tends to stretch more than a full grain leather, especially when wet. This stretching seems to be the basis for some of the complaints about glove bulkiness. To our knowledge, the Forest Service specification forest workers' glove has never been exposed to the hostile conditions experienced in the Lauder entrapment and we do not know if it would perform better or worse under such conditions. We do know from several entrapments that firefighters have been able to remove their shelters readily while wearing gloves and expect that initially the light-colored full-grain leather would provide better radiant heat protection. We recognize that CDF is constrained in their glove design options by CAL-OSHA. However, if the CDF has reservations about the suitability of their glove design and performance, these comments may be helpful in getting CAL-OSHA to re-evaluate their requirements.

HARD HATS

Findings--None of the plastic hard hats showed major failure. Slight deformities and burns were present on some of them. Hard hats were equipped with ear muff hearing protectors, all of which were in the up or unused position on the helmets.

Comments--None.

FACE PROTECTION

Findings--All crew members had goggles and Nomex shroud-style face shields. Goggles were stowed on the hard hat and apparently were not used.

One pair of goggles was the Forest Service specification type stocked by GSA. This goggle has a wire mesh screen for ventilation. The frame of this pair was melted and indications are that heat retention by metal screen may have contributed to the melting. Other goggles were the rubber frame dust and smoke style made by Bouton Inc. These goggles were all blackened with deformed lenses, but the frames were not seriously burned and remained intact.

All victims were reported to have face burns from the bridge of the nose to the neck, which suggests that, since goggles were not worn, the victims had their heads down and either the hard hat bill shielded the upper face and/or they shielded their faces with their forearms.

How Nomex shrouds were deployed by each firefighter is a bit unclear according to the CDF investigation team. The investigative team was unable to establish if the fatality victim wore his Nomex shroud in fully deployed face protection configuration or simply as a neck drape prior to shelter deployment. The shroud on his hard hat showed burn and heat damage only along the bottom edge. The lower edge of nylon velcro used to fasten the shroud closed was also charred and temperature set.

According to the investigation team, the face shroud was totally deployed correctly by Firefighter Murias. Brown and Smith wore theirs positioned behind the head as a neck drape. Ear and neck burns of the victims support this fact. Because Captain MacDonnel's helmet was blown away while trying to assist Cullins the Investigative Team was unable to draw any conclusions in his regard.

Comments--The use of shrouds made of Nomex or FRT cotton for neck, ear, and face protection is a fairly common practice by California firefighters from all agencies, including the Forest Service. In the past, MTDC has discouraged Forest Service use of the shrouds because: (1) They provide comfort against radiant heat, which allows a firefighter to work longer and closer to intense heat. Working so close to flames is seldom necessary in wildfire control and the firefighter pays a heat stress penalty by doing so; (2) The shrouds provide some protection against radiant heat, but not super-heated air and gases, and therefore they provide little protection against life-threatening hazards. Radiant heat protection limitations of Nomex are illustrated by the burns the victims received on their legs and arms. A shroud made of reflective material would provide greater radiant heat protection than the materials currently being used; (3) In the stowed position inside the hard hat, they block off the flow of air between the shell and suspension system that provides cooling of the head. Studies vary, but most indicate that 15 percent or more of the body heat is lost through the head. Blocking this ventilation and heat loss path is an important heat stress consideration.

Should wildland firefighters wear face shrouds? We don't think so. But, we believe this topic needs in-depth study. If shrouds are indeed valuable protection, everyone should have them. If they are neutral to life and death hazards, firefighters should know this and perhaps using shrouds should be discouraged officially.

SAWYERS CAPS

Findings--One member of the crew wore a pair of commercial or CDF design chainsaw chaps made with cordura nylon outer material. There was no apparent damage to the chaps and reportedly the front of his legs were unburned, so the chaps undoubtedly provided additional protection to the wearer.

Comments--Since this investigation we have received field reports expressing concern that the cordura nylon used in the firefighters field pack system could burn and present a safety hazard if the pack is worn in the fire shelter as recommended in the pamphlet Your Fire Shelter. The Forest Service also uses cordura nylon as the outer material in chain saw chaps. Ease of ignition and flamability of nylon is largely a function of weight and weave. Heavy 8-ounce or greater cordura nylon is difficult to ignite and as illustrated by the CDF sawyers chaps, the material was not a thermal hazard either in fleeing from entrapment or in the fire shelter environment.

FOOT PROTECTION

Findings--Crew members wore leather logger-style boots. All were unburned except for the fatality victim. His left boot was severely charred.

Comments--The evidence from this and past fires indicates that the leather boots with good boot socks (preferably wool) provide thermal protection compatible with agency-furnished PPE. The fatality victim's left boot was burned, but this occurred because the shelter material burned that was in contact with his boot.

APPENDIX I.--ANALYSIS OF FIRE SHELTERS

No.	Manufacturer, Date Contract No.	Observations	Estimated Temperature
1	Anchor Nov. 1985 GS-08F-37855	A. No damage or discoloration of shelter B. Retardant mostly on one side	Below 450°F
2	Anchor Nov. 1978 GS-085-34080	A. No damage or discoloration of shelter B. Retardant mostly on one side C. Older model, no hold down flaps	Below 450°F
3	Anchor April 1987 GS-08F-15308	A. 10 sq. in. adhesive discoloration near (head) end, centered. No delamination. No foil damage on clear side (bottom of shelter. B. Retardant mostly on one side.	500° to 700°
4	Cecile Jan. 1983	A. No discoloration B. Fairly extensive mechanical damage; holes and tears. C. One end of shelter never opened. D. Retardant mostly on one side.	Below 450°
5	Anchor December	A. Discoloration on down slope half of shelter on aluminum. B. Adhesive char and delamination on downslope end of shelter and on top surface. C. Spotty aluminum and adhesive dis- coloration on clear (bottom) surface. D. Retardant mostly on one side; same on inside near top.	1200+ 1200+ 700° to 1400°

(Comments Follow)

Comments

Shelter No. 5 belonged to the fatality victim. Shelter No. 4 belonged to Doug MacDonnel (who had told Marty Wattenburger that his shelter had several tears). These shelters were reportedly deployed side-by-side during the entrapment and were found next to each other by the rescue crew.

An analysis of shelters No. 4 and 5 suggests they were either separated in time or significantly spatially separated. Shelter No. 5 was involved with actual flame contact in temperature exceeding 1200^oF. Shelter No. 4 had temperatures below 450^oF. It is very unlikely these shelters were originally deployed together as photographed.

An analysis of shelters No. 4 and 5 suggests they were either significantly separated in time or space. Shelter No. 5 was involved with direct flame contact in temperatures exceeding 1200^oF. Shelter No. 4 showed no signs it had been in temperatures above 450^oF. According to the CDF Investigation team, "the firefighters entered the burn only seconds apart. If the "burn" means entrapment site then the shelter analysis indicates these two shelters were separated a significant distance. However, if Cullins deployed his shelter with his feet up against a burning log (point source) the distance would only need to be 8-10 feet. This would raise the question of why Cullins would stay in such intense heat when the others were at much more favorable locations. Any movement up or to the side would have brought immediate relief.

Several years ago a shelter more extensively damaged than Dennis Cullins' was returned to MTDC. The occupant of the shelter received foot burns but was otherwise ok. There are no indications that Shelter No. 5 failed in performance. Shelter burn injuries to Cullins would have been due primarily to the non-standard deployment, which allowed conductive burns.

APPENDIX II.--KEY INFORMATION SOURCES

PERSON	ORGANIZATION
Jim Wattenburger	CDF--Sonoma (Captain)
Marty Wattenburger	CDF--Forest Helitack Captain
Jim Purcell	CDF--Resource Forester Ukiah
Mike McKay	CDF--Resource Forester Ukiah

Official Investigation Team

Bill Harrington (Team Leader)	CDF--Assistant Chief Region 1, Santa Rosa
Dave Ebert	CDF--Battalion Chief (Wildland Fire Control Instructor) Ione Fire Academy
Robert W. Hackbart	CDF--Safety Coordinator, Sacramento
John J. McCurnin	CDF--Fire Control Officer, Santa Rosa

APPENDIX III.--FIGURES

Figure 1.--Looking upslope at entrapment site. Flagging represents center of each fire shelter location. Fatality victim was in the left end position.

Figure 2.--Looking in 4 o'clock direction at entrapment site. Leaves can be seen on taller shrubs.

Figures 3 and 4.--Char remains of branches, roots, etc. that were underneath shelters.

Figures 5 and 6--Exterior damage to fatality victim's shelter at foot end.

Figure 7.--Interior view of damage.

Figure 8.--Retardant on inside surface of shelter. This is portion of shelter that was not covering the fatality victim.